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June 16, 2017

Noise Monitoring Adjacent to Waste Connections Well Site April 25th to May 31st, 2017

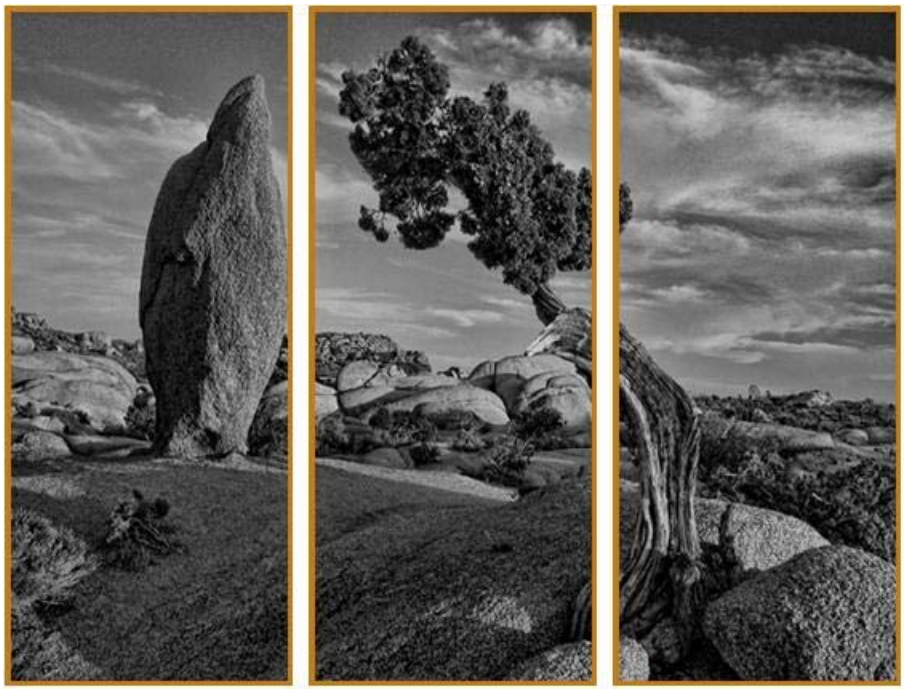
Noise Monitoring of Crestone Peak Resources Operations Erie, Colorado

Prepared For:

Town of Erie
645 Holbrook Street
Erie, CO 80516

Pinyon Project No.:

11769502



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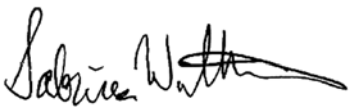

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Reviewed by:

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1. Introduction

The Town of Erie (Town) has contracted with Pinyon Environmental (Pinyon) to perform noise monitoring near the Crestone Peak Resources (Crestone) Waste Connections well site. Pinyon collected continuous noise measurements at two locations adjacent to the well site. Sampling Site 1 is located approximately 350-feet to the southeast of the well site and collected A-weighted noise measurements. Sampling Site 2 is located near a residential neighborhood approximately 1,400-feet to the southwest of the well site and collected both A-weighted and C-weighted noise measurements. Crestone began deploying vehicles and equipment to the Waste Connections well site at approximately 7:00 AM on April 25, 2017. This report details noise measurements collected from April 25, 2017 at 7:00 AM through May 31, 2017 at 7:00 PM. The noise monitoring data was analyzed to evaluate noise levels at the two locations during Crestone's well production activities.

2. Methodology

2.1 Noise Monitoring Approach

In accordance with Colorado Oil and Gas Conservation Committee (COGCC) rule 802, well production facilities may not exceed the maximum permissible noise levels established in accordance to section 802.b of the rule as shown in Table 2-1. In addition to the maximum permissible A-weighted noise levels, expressed in A-weighted decibels (dBA) shown in Table 2-1, COGCC rule 802 specifies that operators may not exceed 65 C-weighted decibels (dBC) measured from the exterior wall of the residence or occupied structure nearest to the noise source at a distance of 25-feet from the structure.

Table 2-1 COGCC Maximum Permissible Noise Levels

Zone	Maximum Permissible Noise Level	
	7:00am to 7:00pm	7:00pm to 7:00am
Residential/Agricultural/Rural	55 dBA	50 dBA
Commercial	60 dBA	55 dBA
Light Industrial	70 dBA	65 dBA
Industrial	80 dBA	75 dBA

dBA A-weighted decibel

Pinyon mobilized to Sampling Site 1 and Sampling Site 2 and monitored for noise at these locations using 3M Quest SoundPro DL Type 1 datalogging sound level meters. The sound level meters collected continuous measurements of both A-weighted and C-weighted decibels, as applicable to the location. At Sampling Site 1 the sound level meter monitored continuously for A-weighted noise. Sampling Site 2 collected continuous A-weighted and C-weighted noise. The monitoring period for this report lasted from April 25th, 2017 at 7:00 AM through May 31st, 2017 at 7:00 PM. Crestone began drilling operations at the well site at approximately 6:00 AM on April 25th, 2017 and has continued well production activities throughout this reporting period.

The sound level meters are configured with a data logging system that uploads one minute time resolved measurements to a secure online database at ten minute intervals. Pinyon's Noise Specialist and Field Technicians have been provided an account to access the database including username and password. The sound level meters are configured with an alert system that send a message to Pinyon's Noise Specialist as soon as the data is uploaded indicating that established noise criteria levels based on whether the monitored equivalent continuous noise level (Leq) has been exceeded. Leq is the preferred method to describe noise levels that vary over time, resulting in a single decibel value that takes into account the total sound energy over the period of time of interest. The Town and Pinyon agreed to set the alert system at 70 Leq dBA for A-weighted noise at Sampling Site 1, 70 Leq dBA for A-weighted noise at Sampling Site 2 and 70 Leq dBC for C-weighted noise at Sampling Site 2. These noise criteria levels were established based on the COGCC's maximum permissible noise levels, as well as baseline noise monitoring data collected prior to Crestone mobilizing to the well site. The C-weighted noise alert criteria level at Sampling Site 2 is set higher than the COGCC's maximum permissible noise level because baseline noise measurements collected prior to Crestone's operations exceeded this level. In general, the noise criteria levels reflect a 3 decibel increase from baseline noise levels. A 3 decibel increase in noise is considered to be barely perceptible to the human ear.

2.2 Noise Monitoring Data Analysis

Pinyon's Noise specialist downloaded the noise monitoring data from the online database for this collection period. The data was then formatted into spreadsheets that allowed for analysis of the noise monitoring data.

Pinyon utilized statistical methods, as well as graphical representations of the data, to determine baseline noise levels at the two sampling locations during the monitoring period. The baseline analysis of the monitor data, indicated differences in observed noise levels based on day of week; however, statistically significant differences between weekday and weekend noise levels were not observed during this monitoring period. This is likely because Crestone is operating on a seven-day a week schedule and not altering their activities on the weekends. COGCC's rule 802 specifies different maximum permissible noise levels based on time of day. Therefore, for the statistical analysis of the noise measurements, the monitor data was split into two discrete analytical groups based on time of day:

- Daytime: 7:00 AM—6:59 PM
- Nighttime: 7:00 PM—6:59 AM

In order to evaluate how noise levels may change over time during Crestone's operations at the well site, the monitoring data was separated into the following discrete monitoring periods with each monitoring period then subdivided by time of day:

- April 14th to April 25th, 2017 (Baseline Monitoring Period)
- April 25th to April 30th, 2017
- May 1st to May 7th, 2017
- May 8th to May 14th, 2017
- May 15th to May 21st, 2017
- May 22nd to May 31st, 2017

Section 3-2 describes how differences in the statistical mean between these monitoring periods were analyzed to confirm the existence of statistically significant increases in average observed noise levels as compared to the baseline monitoring period. To determine the distribution of the noise monitoring data, the statistical mean, median and mode were calculated. The statistical mean, median and mode are used to evaluate the statistical distribution of the noise monitoring data. Large data sets, such as several days of continuous noise monitoring data tend to follow the normal distribution, which is referred to as the central limit theorem. Determining the distribution of the noise monitoring data is important because this distribution is used to determine the appropriate statistical methods for further analysis. The observed relationship between the statistical mean, median and mode for the monitored datasets was determined to follow the normal distribution. The standard deviation for each monitoring periods was also calculated to evaluate the amount of variation in the baseline noise monitoring data.

3. Data Analysis Results

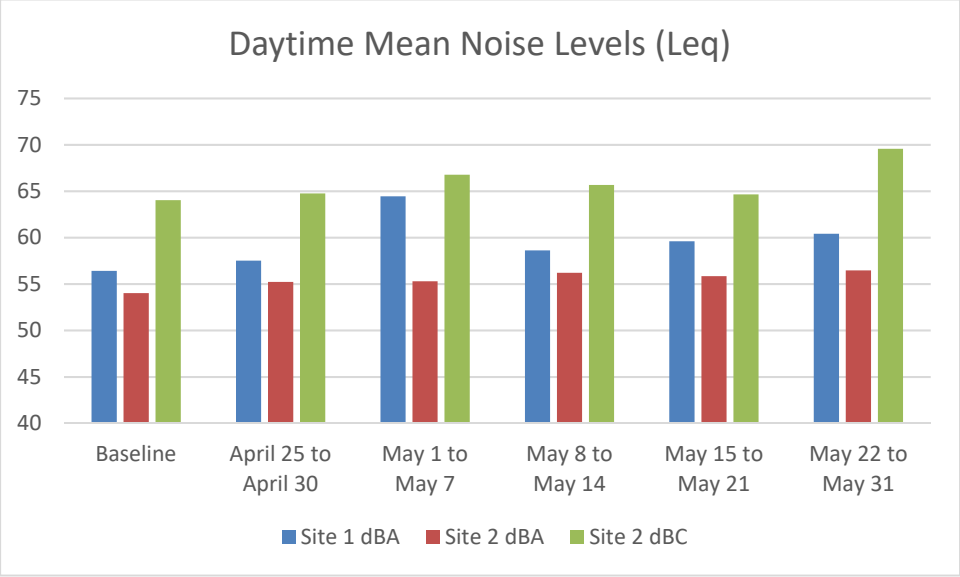
3.1 Graphical Representations of Data

Pinyon evaluated the noise monitoring data and generated several graphs that represented average and maximum noise level conditions during the monitoring periods. This section presents those graphs along with a narrative describing noise monitoring conditions during the sampling periods described in Section 2-2.

3.1.1 Average Daytime Conditions

The statistical mean for each noise monitoring period was calculated for the daytime hours (7:00 AM to 6:59 PM) as shown in Figure 3-1. Noise levels were variable between the monitoring periods with the largest increases relative to the baseline observed at Site 1.

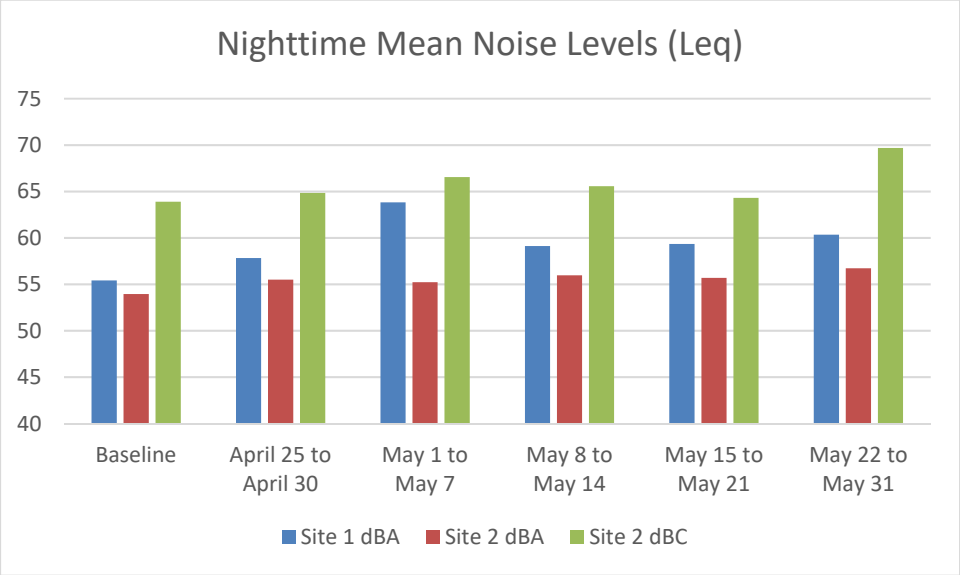
Figure 3-1 Average Daytime Noise Levels



3.1.2 Average Nighttime Conditions

Figure 3-2 shows the statistical mean of noise monitoring data collected during the nighttime period (7:00 PM to 6:59 AM). The largest increases in average noise levels were observed at Site 1 and the C-weighted noise monitor at Site 2. Only slight increases in average A-weighted noise were observed at Site 2.

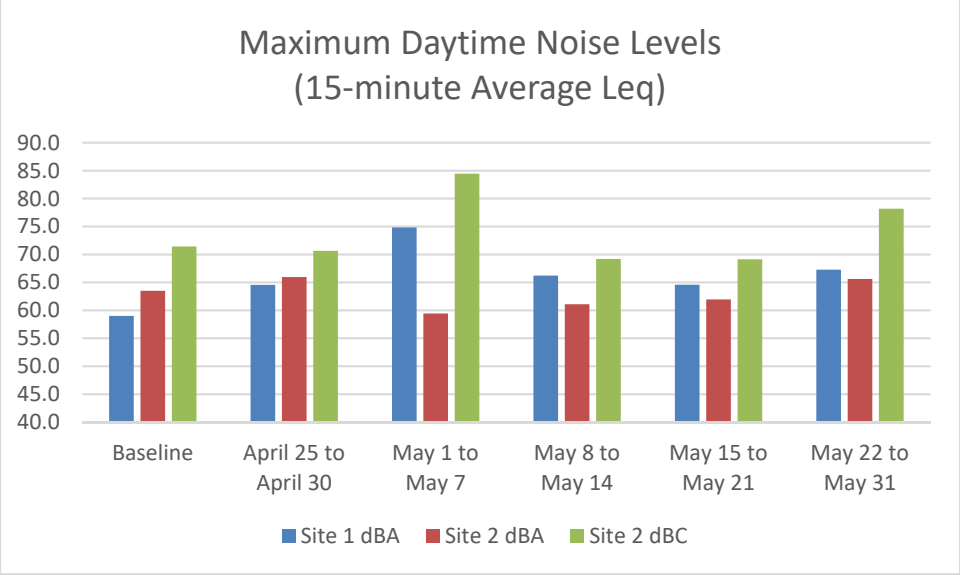
Figure 3-2 Average Nighttime Noise Levels



3.1.3 Maximum Observed Daytime Noise Levels

Figure 3-3 shows the maximum 15-minute average noise measurements collected during the daytime condition during the monitoring periods. No exceedances of the COGCC's maximum permissible noise criteria were observed for A-weighted noise at Site 1 or Site 2. The maximum permissible noise criteria for C-weighted noise continued to be above 65 dBC; however, this was also observed during the baseline period prior to Crestone beginning activities at the well site.

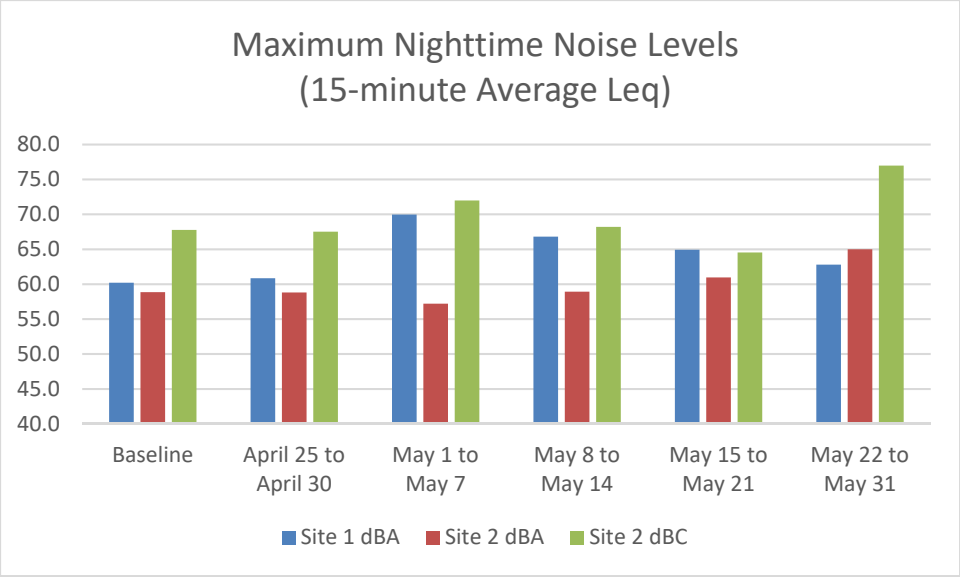
Figure 3-3 Maximum Daytime Noise Levels



3.1.4 Maximum Observed Nighttime Noise Levels

Figure 3-4 shows the maximum 15-minute average noise measurements collected during the nighttime condition during the monitoring periods. No exceedances of the COGCC's maximum permissible noise criteria were observed for A-weighted noise at Site 1 or Site 2. The maximum permissible noise criteria for C-weighted noise continued to be above 65 dBC; however, this was also observed during the baseline period prior to Crestone beginning activities at the well site.

Figure 3-4 Maximum Nighttime Noise Levels



3.2 Statistical Analysis of Noise Monitor Data

3.2.1 Increase in Mean Noise Levels as Compared to the Baseline Monitoring Period

Pinyon observed an increase in the statistical mean of the measured noise values from the baseline monitoring period while analyzing the monitoring data. Furthermore, this difference was also observed when generating graphical representations of the measured noise values at the three noise monitors for the six monitoring periods. A t-test was performed to determine whether the difference in calculated mean values were statistically significant. A t-test is a statistical method for evaluating the difference in means between two sample groups. The higher the t-value the greater the difference between the two means. To assess the level of confidence in the calculated t-value, a p-value is calculated. The p-value is based on the magnitude of the t-value and the total number of samples collected between the two monitoring periods. A p-value of less than or equal to 0.001 means that there is a 99.9% confidence level that the difference between means is statistically significant.

Tables 3-2 through 3-7 show the variation in statistical mean, the t-value and the p-value during the monitoring periods for the three monitoring sites. The calculated p-values were less than 0.001 for all comparisons meaning that the means are statistically significantly different at the 99.9% confidence interval. Site 1 exhibited the greatest increase in mean monitoring values from the baseline for A-weighted noise, which is expected as it is located much closer to Crestone's activities at the well pad than Site 2. Site 2 monitoring data showed a

smaller, but still statistically significant increase, in mean noise measurements for both A-weighted and C-weighted noise. The increase in A-weighted noise at Site 2 was less than three decibels for all monitoring periods as compared to the baseline. An increase of less than three decibels is considered to be barely perceptible to the human ear. The increase in measured C-weighted mean noise levels at Site 2 was also less than three decibels except for the May 22nd to May 31st, 2017 monitoring period where the measured increase was 5.6 decibels.

Table 3-2 Variation in Daytime Statistical Mean for A-weighted Noise at Site 1 Leq (dBA)

Period	Mean	Change	t-value	p-value
Baseline	56.4	NA	NA	<0.001
April 25th to April 30th	57.5	1.1	14.3	<0.001
May 1st to May 7th	64.4	8.0	94.2	<0.001
May 8th to May 14th	58.6	2.2	30.8	<0.001
May 15th to May 21st	59.6	3.2	103.2	<0.001
May 22nd to May 30th	60.4	4.0	93.8	<0.001

dBA A-weighted decibels

Table 3-3 Variation in Nighttime Statistical Mean for A-weighted Noise at Site 1 Leq (dBA)

Period	Mean	Change	t-value	p-value
Baseline	55.4	NA	NA	<0.001
April 25th to April 30th	57.8	2.4	41.9	<0.001
May 1st to May 7th	63.8	8.4	144.3	<0.001
May 8th to May 14th	59.1	3.7	47.0	<0.001
May 15th to May 21st	59.3	3.9	89.5	<0.001
May 22nd to May 30th	60.3	4.9	117.3	<0.001

dBA A-weighted decibels

Table 3-4 Variation in Daytime Statistical Mean for A-weighted Noise at Site 2 Leq (dBA)

Period	Mean	Change	t-value	p-value
Baseline	54.0	NA	NA	<0.001
April 25th to April 30th	55.2	1.2	33.3	<0.001
May 1st to May 7th	55.3	1.3	47.6	<0.001
May 8th to May 14th	56.2	2.2	69.8	<0.001
May 15th to May 21st	55.8	1.8	50.6	<0.001
May 22nd to May 30th	56.4	2.4	58.8	<0.001

dBA A-weighted decibels

Table 3-5 Variation in Nighttime Statistical Mean for A-weighted Noise at Site 2 Leq (dBA)

Period	Mean	Change	t-value	p-value
Baseline	54.0	NA	NA	<0.001
April 25th to April 30th	55.5	1.5	60.8	<0.001
May 1st to May 7th	55.2	1.2	51.9	<0.001
May 8th to May 14th	56.0	2.0	79.4	<0.001
May 15th to May 21st	55.7	1.7	47.8	<0.001
May 22nd to May 30th	56.7	2.7	93.0	<0.001

dBA A-weighted decibels

Table 3-6 Variation in Daytime Statistical Mean for C-weighted Noise at Site 2 Leq (dBC)

Period	Mean	Change	t-value	p-value
Baseline	64.0	NA	NA	<0.001
April 25th to April 30th	64.8	0.8	18.9	<0.001
May 1st to May 7th	66.8	2.8	70.0	<0.001
May 8th to May 14th	65.7	1.7	49.7	<0.001
May 15th to May 21st	64.7	0.7	15.3	<0.001
May 22nd to May 30th	69.6	5.6	136.3	<0.001

dBC C-weighted decibels

Table 3-7 Variation in Nighttime Statistical Mean for C-weighted Noise at Site 2 Leq (dBC)

Period	Mean	Change	t-value	p-value
Baseline	63.9	NA	NA	<0.001
April 25th to April 30th	64.8	0.9	35.6	<0.001
May 1st to May 7th	66.6	2.7	87.7	<0.001
May 8th to May 14th	65.6	1.7	63.1	<0.001
May 15th to May 21st	64.3	0.4	15.7	<0.001
May 22nd to May 30th	69.7	5.8	170.5	<0.001

dBC C-weighted decibels

4. Conclusions

Pinyon collected continuous noise measurements at two monitoring locations adjacent to Crestone's Waste Connections well site from April 14th, 2017 to May 31st, 2017. On April 25th, 2017 at approximately 6:00 AM Crestone commenced drilling operations at the well site and has continued activities throughout this reporting period. An evaluation of the noise measurements collected showed an increase in ambient noise levels likely attributable to Crestone's activities during this reporting period at both monitoring locations. Analysis of the noise measurements indicated statistically significant differences between observed mean values for the six monitoring periods, which were broken down between daytime and nighttime hours.

During this reporting period, there were no exceedances of the COGCC's maximum permissible A-weighted noise levels at Site 1 or Site 2 during daytime or nighttime hours. The COGCC's maximum permissible C-weighted noise levels were exceeded at Site 2 on several occasions. Exceedances of the COGCC's maximum permissible C-weighted noise levels were also observed during the baseline monitoring periods; therefore, a determination cannot be made as to whether elevated C-weighted noise at Site 2 is directly attributable to Crestone's activities at the well site. It is possible that some degree of the increase in C-weighted noise is attributable to activity in the neighborhood adjacent to Site 2.

Pinyon will continue to monitor continuously for noise at Site 1 and Site 2 throughout Crestone's operations at the well site and will compare measured levels of A-weighted and C-weighted noise to baseline levels in order to assess potential changes in ambient noise levels during various phases of activity and determine if exceedances of the COGCC's maximum permissible noise levels are observed.